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Santa Clara Valley Water District

Groundwater Conditions 72-73

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SANTA CLARA VALLEY WATER DISTRICT

ANNUAL SURVEY REPORT
ON
GROUNDWATER CONDITIONS

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SUMMARY OF 1972-73
GROUNDWATER CONDITIONS

Santa Clara County experienced a substantial rise in water levels in its groundwater basins for the water year July 1, 1972 through June 30, 1973. One of the wettest years on record, 1972-73 ended with increases of groundwater in storage of 53,000 acre-feet in the Santa Clara Valley Groundwater Basin, 10,000 acre-feet in the Coyote Groundwater Basin and 33,000 acre-feet in the Llagas Groundwater Basin.

During this same period, the District imported 92,584 acre-feet of water through the South Bay Aqueduct. The Rinconada Water Treatment Plant treated 44,992 acre-feet of this water and most of the remaining 47,592 acre-feet was diverted to District facilities for groundwater recharge. The District has requested 100,000 acre-feet from the State for the 1974 calendar year.

No further land subsidence was detected in 1972-73, as all benchmarks have remained at 1969 elevations.

Groundwater continues to be high quality water usable for all beneficial purposes. Certain localized areas have yielded groundwater inferior in mineral quality. Analysis of groundwater chloride-concentration data indicates that the limits of sea water contamination in most places have not changed significantly during the period 1949 through 1972.

INTRODUCTION

This is the annual report on groundwater conditions in the three major groundwater basins of Santa Clara County for water year 72-73 which runs from July 1, 1972 to June 30, 1973. The purpose of this report is to inform the District Board of Directors and interested citizens of the current condition of our groundwater basins. The three major groundwater basins, which are interconnected and occupy nearly 30 percent of the total county area, are the Santa Clara Valley, Coyote and Llagas Basins. The location of these basins is outlined on Plate 1. Groundwater supplies nearly 60 percent of the total water used in the Santa Clara Valley Basin and nearly all of that used in the Coyote and Llagas Basins.

Zones of benefit have been established for the conservation, importation, treatment and distribution of water used in Santa Clara County. These zones are shown on Plate 1.

Zone W-2 encompasses the Santa Clara Valley groundwater basin and was formed for the registration of those groundwater producing facilities that benefit from recharge of the groundwater basin by the District with local and imported water. In this zone, a charge is levied for groundwater extracted and the revenue thus derived is used to support the District's conservation and importation program. The major source of water supply income is the groundwater charge levied in Zone W-2 and the sale of treated water.

Zone W-4 encompasses all of Zone W-2 plus the lands of water consumers outside of Zone W-2 that use or otherwise benefit from locally conserved water and from the importation and distribution of water from the South Bay Aqueduct. In this zone, a property tax is levied to pay for the cost of water purchased to recover the accumulated overdraft in the groundwater basin.

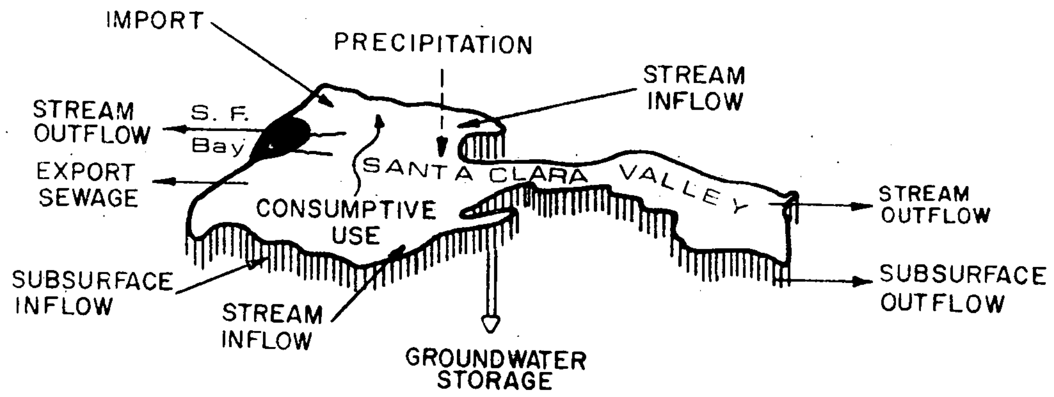
In Zone W-3, comprising most of the Coyote Basin, an ad valorem tax is levied in lieu of a groundwater charge. The three subzones within Zone W-3 were formed for the purpose of assessing a groundwater charge on pumping facilities that export water from the Coyote Groundwater Basin to areas outside of Zone W-3. No groundwater charge is levied in the Llagas Basin by this District.

HYDROLOGIC BALANCE

Last year's abundant rainfall (165% of normal at San Jose) made 1972-73 a good water supply year resulting in an increase in water stored in the District's groundwater reservoirs.

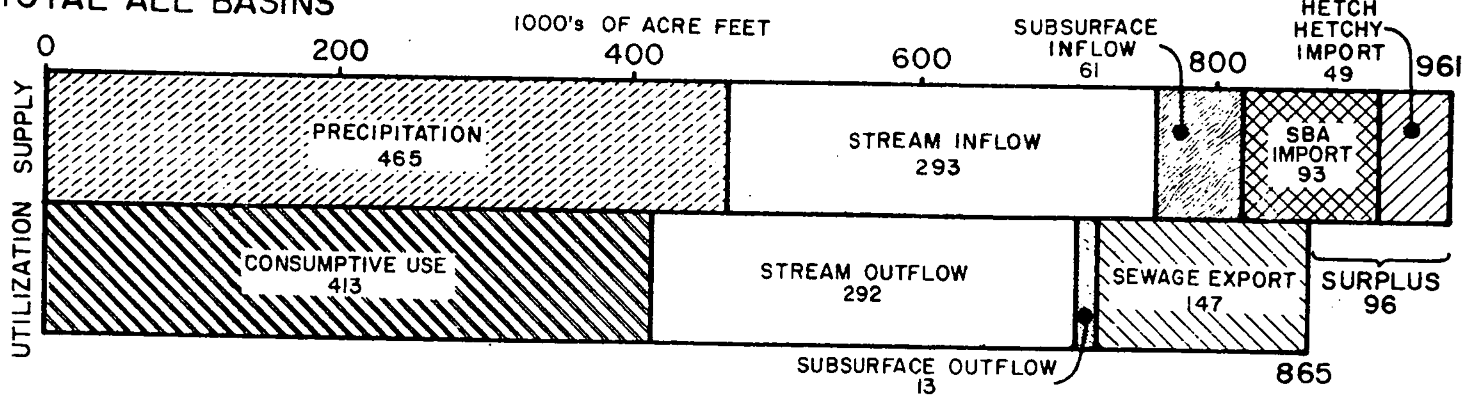
The volume of water in storage changes as water levels rise and fall. This change of stored water in the unconfined zone, can be computed by multiplying estimates of the storage coefficient for the aquifer materials by the area and by the change in depth between groundwater levels at the beginning and end of the year (Plate 3). This year increases of 49,000 acre-feet in the Santa Clara Valley Basin, 10,000 acre-feet in the Coyote Basin and 37,000 acre-feet in the Llagas Basin were computed.

These estimates were checked by balancing the hydrologic components of water supply and utilization. Water supply consists of precipitation, stream inflow, imported water and subsurface inflow. Water is utilized or lost by consumptive use, sewage export, stream outflow and subsurface outflow. The difference between supply and utilization is the net surplus or deficit of water in storage in the groundwater reservoirs at the end of the season. The hydrologic balance, illustrated in Figure 1, shows that the increase in the Santa Clara Valley Basin was 53,000 acre-feet, the increase in the Coyote Basin was 10,000 acre-feet, the increase in the Llagas Basin was 33,000 acre-feet, (these compare favorably to the previously obtained surpluses of 49,000; 10,000 and 37,000 acre-feet respectively).



SCHEMATIC HYDROLOGIC BALANCE

TOTAL ALL BASINS



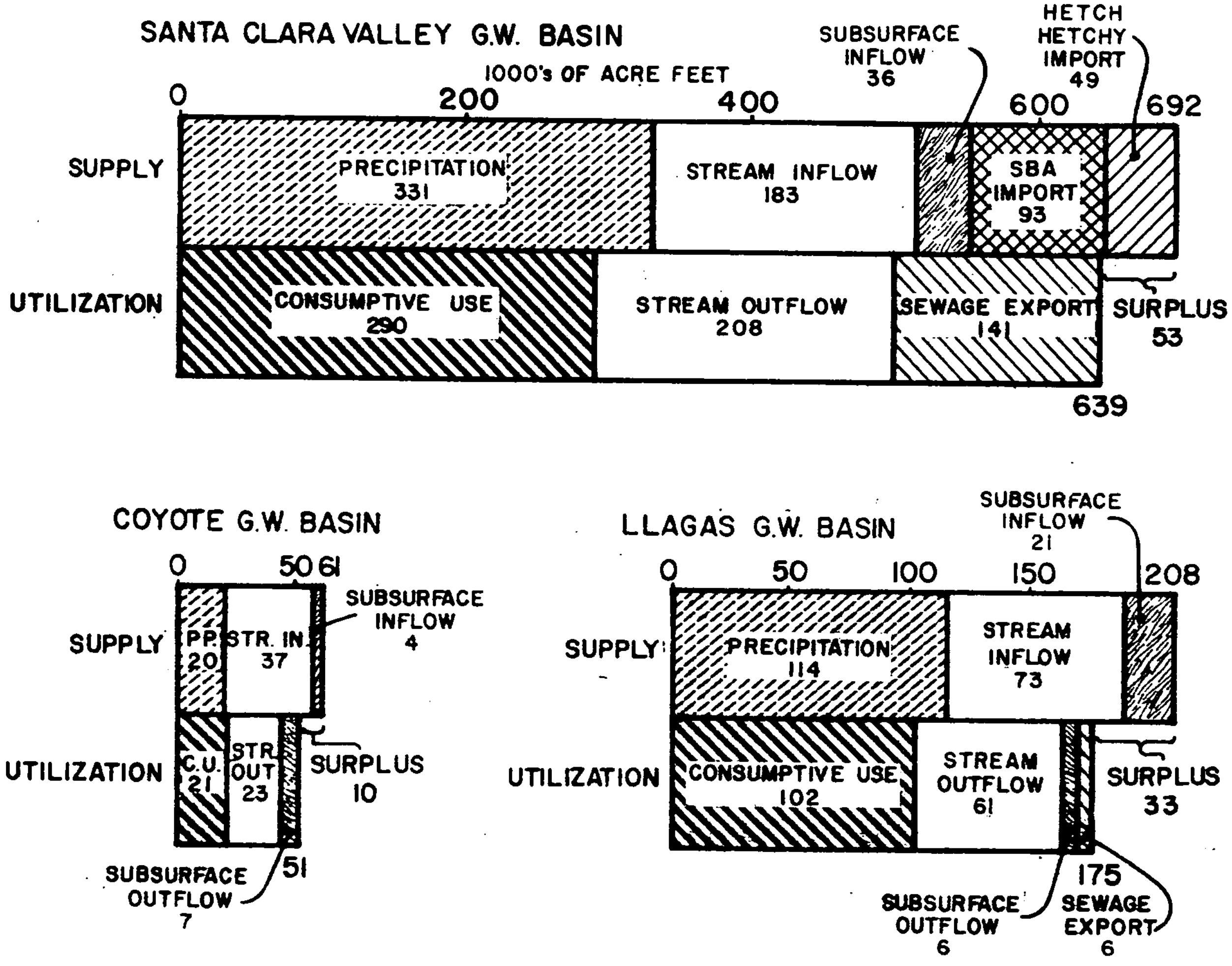


FIGURE I. HYDROLOGIC BALANCE OF GROUNDWATER 1972-73
(VALUES IN 1000's ACRE FEET)

Fig. 1

The discrepancy observed between the storage changes obtained as a net balance of hydrologic components and that obtained as a product of change in water levels and storage coefficient is the result of uncertainties involved in the estimation of subsurface inflows, consumptive use and the storage coefficient of aquifers. However, the results are well within the accuracy acceptable for this kind of computation.

IMPORTED WATER

The primary source of imported water for Santa Clara County is the South Bay Aqueduct. During the 1972-73 water year, 92,584 acre-feet of water was delivered into Santa Clara County through the South Bay Aqueduct. Of this total, 44,992 acre-feet was treated at the Rinconada Water Treatment Plant for delivery to consumers through retail water agencies. In addition, 606 acre-feet of raw water was delivered directly from District pipelines for use by individual contractors. The remaining 46,986 acre-feet was percolated through the District's recharge facilities. The total South Bay Aqueduct import for the calendar year 1973 was 91,093 acre-feet. For the calendar year 1974, the District is obligated by contract to purchase its entitlement of 88,000 acre-feet from the State. In addition 12,000 acre-feet of surplus water has been requested for a total expected delivery of 100,000 acre-feet.

A second source of imported water comes from the Sierras via the San Francisco Water Department's Hetch Hetchy Aqueduct. During the water year 1972-73, this system delivered 48,890 acre-feet directly to the water supply systems of the cities of Milpitas, Sunnyvale, Mountain View, and Palo Alto, and to the Purissima Hills County Water District.

GROUNDWATER LEVELS

A groundwater contour map, showing lines of equal elevation of water levels in wells as of September 1, 1973 (traditionally the seasonal low), is shown on Plate 2. Plate 3 shows lines of equal change in depth to water in wells between June 1, 1972 and June 1, 1973. Plate 4 shows lines of equal depth to water as of September 1, 1973.

The monthly fluctuation of water levels from 1968 to 1973 in the Santa Clara Valley, Coyote, and Llagas Basins are presented in Figure 2. These levels represent the weighted average of depths to water in approximately 200 representative wells which are monitored at the beginning of each month. All three groundwater basins have registered an increase in water levels for 1973, following the previous year's dramatic drop. The biggest increase was in the Llagas Basin where the average water level rose 24 feet. The average water level in the Santa Clara Valley Basin rose 16 feet and the Coyote Basin registered an average water level rise of 11 feet.

SEASONAL GROUNDWATER EXTRACTIONS

Table 1 shows the values of seasonal groundwater extractions for the water year 1972-73. Also included in this table are projections of groundwater use in 1973-74 and 1974-75. Values for 1972-73 in the Santa Clara Valley Groundwater Basin are metered

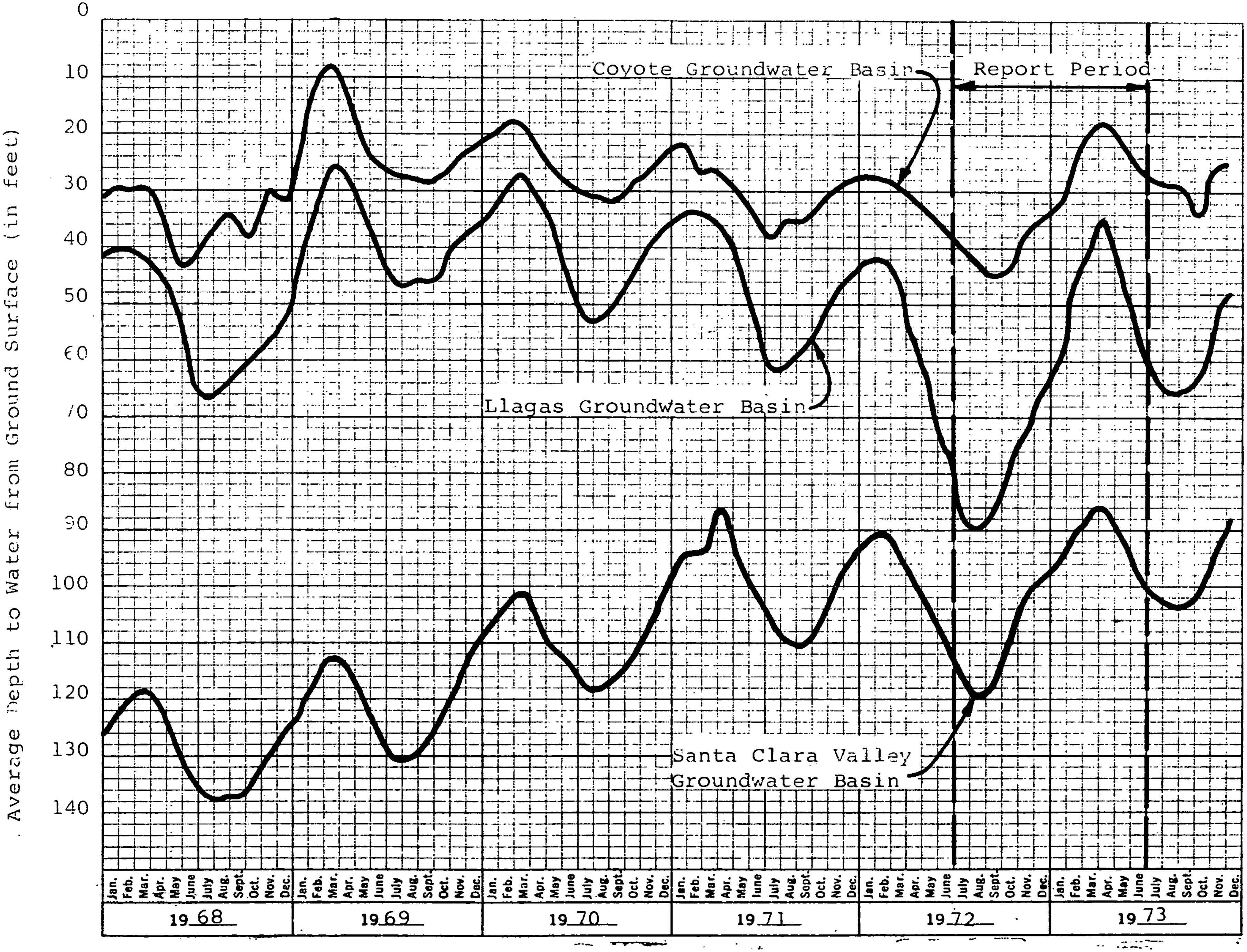


Figure 2. Fluctuations of Average Water Level

Fig. 2

TABLE 1

SEASONAL GROUNDWATER EXTRACTIONS FROM THE GROUNDWATER BASINS OF THE DISTRICT
(VALUES IN ACRE-FEET)

Water Year and Use	Groundwater Basin			Total
	Santa Clara Valley	Coyote	Llagas	
1972-73				
Agric. Use	17,000*	9,000	56,000	82,000
Urban Use	137,000*	2,000	12,000	151,000
Total	154,000*	11,000	68,000	233,000
1973-74				
Agric. Use	18,000	10,000	60,000	88,000
Urban Use	137,000	2,000	13,000	152,000
Total	155,000	12,000	73,000	240,000
1974-75				
Agric. Use	16,000	10,000	62,000	88,000
Urban Use	138,000	2,000	14,000	154,000
Total	154,000	12,000	76,000	242,000

* These are the recorded extractions.

quantities based on statements submitted by groundwater users as required by the groundwater charge program. All other values are estimated based on assumed average year conditions and the assumption that treated water deliveries and artificial and natural recharge quantities will remain at 1972-73 levels.

SUBSIDENCE

Subsidence of the land surface occurs when intensive withdrawal of groundwater results in lowered artesian pressures in areas of groundwater confinement. This increases the effective overburden load on the subsurface materials causing them to compact with correlative subsidence of the overlying land surface. The District annually makes a survey across the north valley to check for subsidence. The survey for 1973 showed no change in elevation of the valley floor from that in 1972. Land surface subsidence has not occurred since 1969 because groundwater levels rose above and have remained above a critical pressure elevation. Figure 3 shows for comparison the average depth to water, land subsidence, the rainfall at San Jose and the population of Santa Clara County for each year since 1908.

The District is continuing its program of recharge of the groundwater basin with local and imported water. More than 100,000 acre-feet are recharged through District facilities annually. A new percolation pond on McClellan Road in Cupertino will be constructed and should be operating during 1974.

FIGURE 3

LAND SUBSIDENCE –

Elevation of U.S. Coast and Geodetic Survey Benchmark P7 in San Jose

DEPTH TO WATER –

Depth to Water, in Feet, in Wells in Santa Clara Valley Groundwater Basin at End of Irrigation Season

POPULATION –

Total Population of Santa Clara County

RAINFALL –

Total Yearly Rainfall at U.S. Weather Bureau Station in San Jose

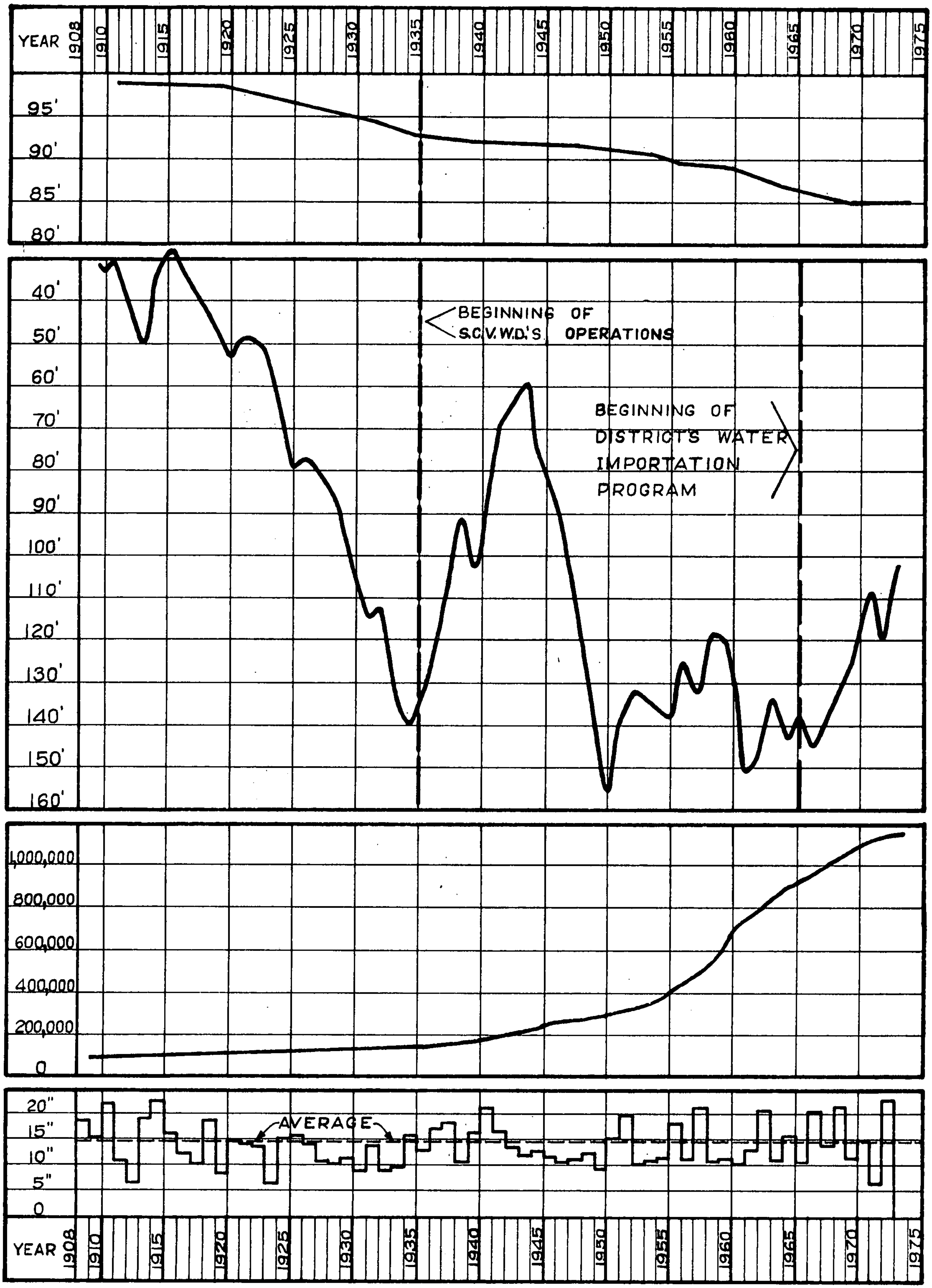

YEAR
1908
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
95'
90'
85'
80'
40'
50'
60'
70'
80'
90'
100'
110'
120'
130'
140'
150'
160'
BEGINNING OF S.C.V.W.D.'S OPERATIONS
BEGINNING OF DISTRICT'S WATER IMPORTATION PROGRAM
1,000,000
800,000
600,000
400,000
200,000
0
20"
15"
10"
5"
0
AVERAGE

FIGURE 3

GROUNDWATER QUALITY

Groundwater in Santa Clara County occurs in both the confined and unconfined condition. The unconfined condition exists along the peripheral areas of the Santa Clara Valley Basin, throughout the Coyote Basin, and in the area north of Rucker Avenue in the Llagas Basin. In the confined areas, groundwater is generally pumped from the deeper aquifers , depths greater than 150 feet. This water is generally a better quality water than is found in the overlying shallow aquifers, less than 150 feet deep.

Groundwater pumped from most of the existing wells in the District's basins is of good quality and in general, meets all requirements for drinking water as set forth in the Standards by the U. S. Public Health Service. Groundwaters from properly constructed and protected wells, including many municipal well fields, are in some places used directly without chlorination.

Certain localized areas yield groundwater of inferior mineral quality. These areas include: (1) the perimeter of San Francisco Bay where the shallow groundwater zone has been contaminated by sea water (see following section on sea water contamination); (2) the Evergreen area where connate water below 300 feet containing high chlorides has been found in the past (this area is continually monitored), and (3) the Penitencia alluvial fan area where highly mineralized groundwater containing excessive quantities of chlorides and boron have been found. Also, some wells in the Los Altos, Morgan Hill and Gilroy areas have at times contained high nitrate concentrations, sometimes exceeding U. S. Public Health Standards, and high fluoride concentrations have been observed in Morgan Hill.

Graphical representations of water quality parameter changes in water from selected wells are shown in Figures 4, 5 and 6. The locations of these wells are shown on Plate 1.

At many of the wells where groundwater of inferior quality is obtained, one of the contributing factors may be the method of well construction. In addition to yielding groundwater of inferior quality, many improperly constructed wells function as channels for the movement of water between contaminated and uncontaminated aquifers. Improper methods of well construction and abandonment, if allowed , could contribute largely to the deterioration of fresh water aquifers. Such a situation has already occurred in adjacent counties near San Francisco Bay. In order to help prevent this from happening in Santa Clara County, the District is working to establish well construction and abandonment standards.

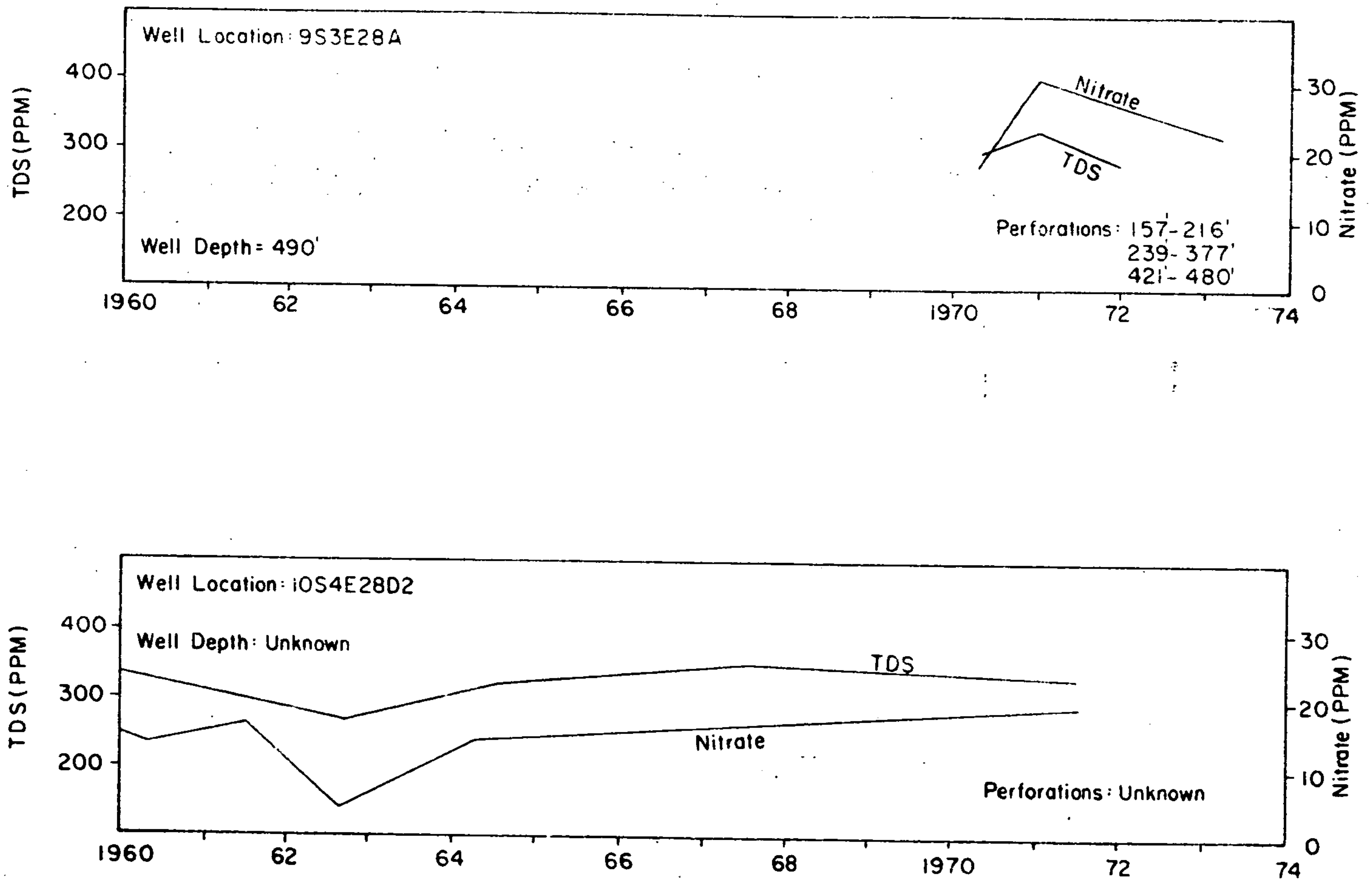


Figure 4. Temporal Variation of Nitrates and TDS-Llagas Basin

Fig. 4

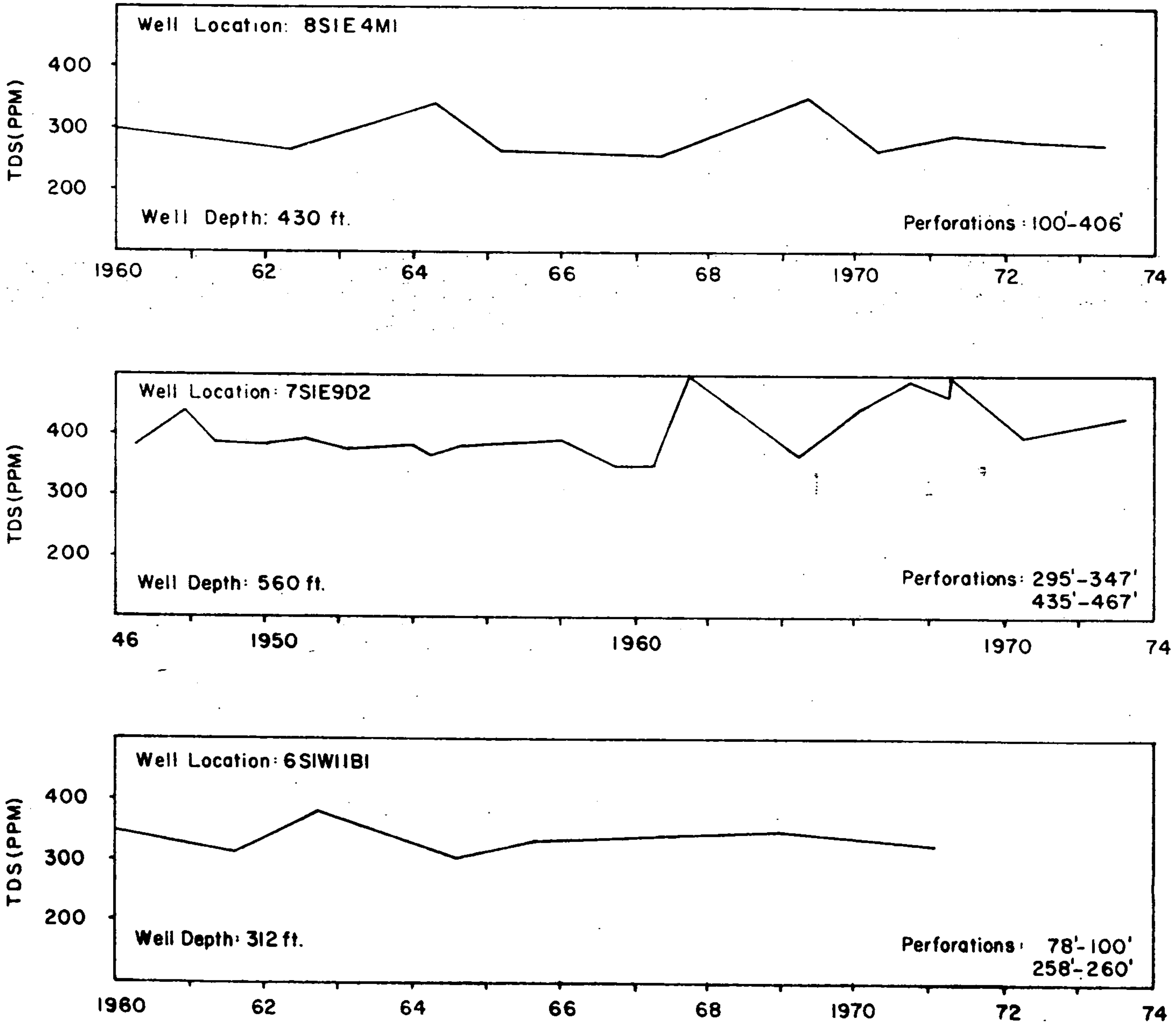


Figure 5. Temporal Variation of TDS-Santa Clara Valley Groundwater Basin

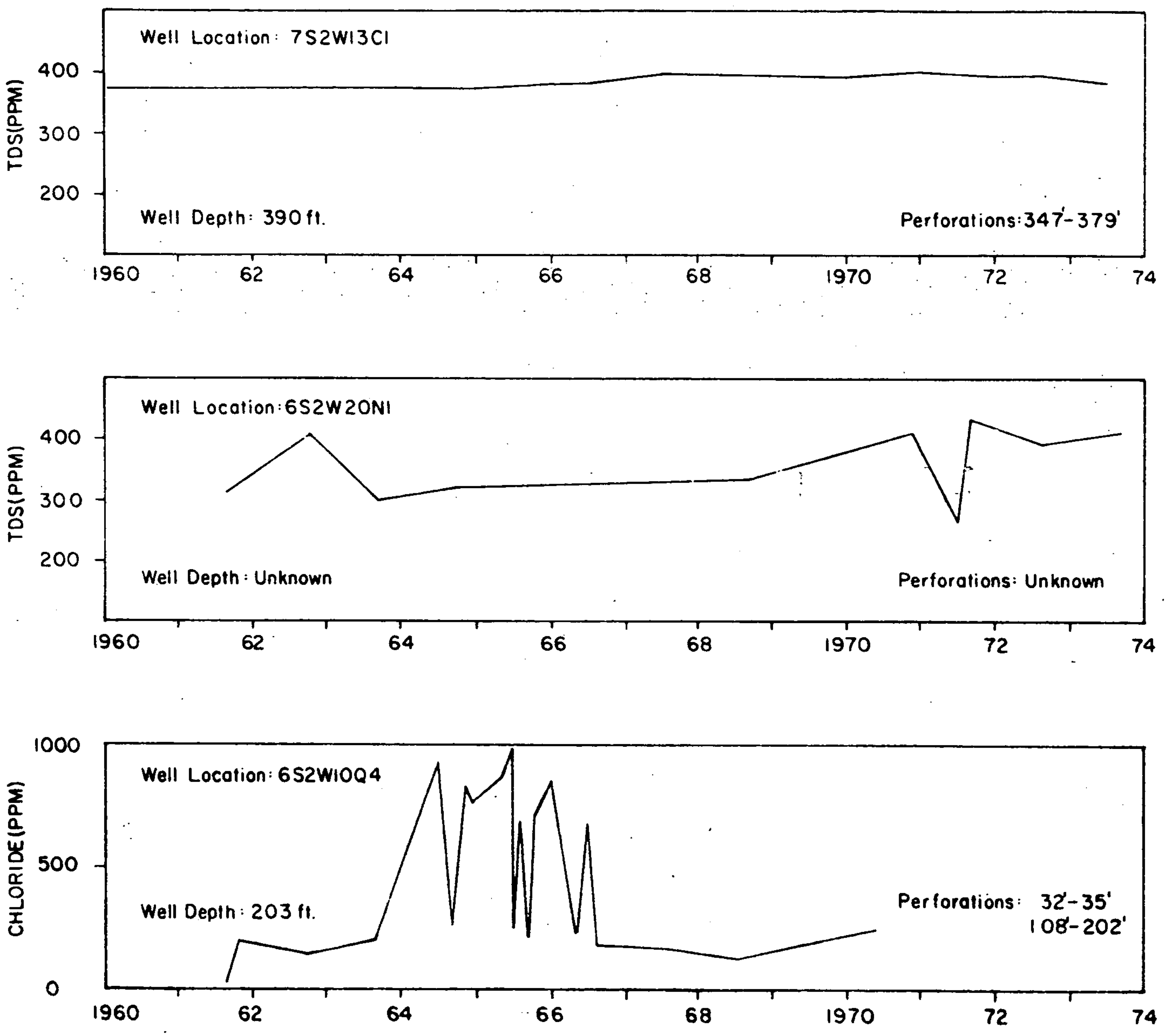


Figure 6. Temporal Variation of TDS and Chloride – Santa Clara Valley Groundwater Basin

SEA WATER CONTAMINATION

Sea water contamination as used herein is a broad term that covers all mechanisms of degradation of fresh water by sea water including sea water intrusion; sea water intrusion implies mass transfer via groundwater flow from a body of sea water into a body of fresher water as a result of a landward or relatively flat hydraulic gradient.

The extent of sea water contamination in the Santa Clara Valley Groundwater Basin has been monitored by the District for several years by sampling selected wells. Water from these selected wells is analyzed for chloride content.

High chloride concentrations do not by themselves prove sea water contamination; however, aquifers in this area are believed to be protected from other known chloride sources by overlying extensive clay layers.

A study performed by the District in 1972 suggested that electrical resistivity may be a useful tool for mapping and monitoring sea water contamination from San Francisco Bay and adjacent stream channels. In the fall of 1973, the District's sea water contamination monitoring program was expanded. As part of this program an electrical resistivity geophysical survey was instigated, well sampling for chloride was expanded in the Milpitas-Sunnyvale-Agnew area and all available historic chloride, geologic, and well-depth data were evaluated.

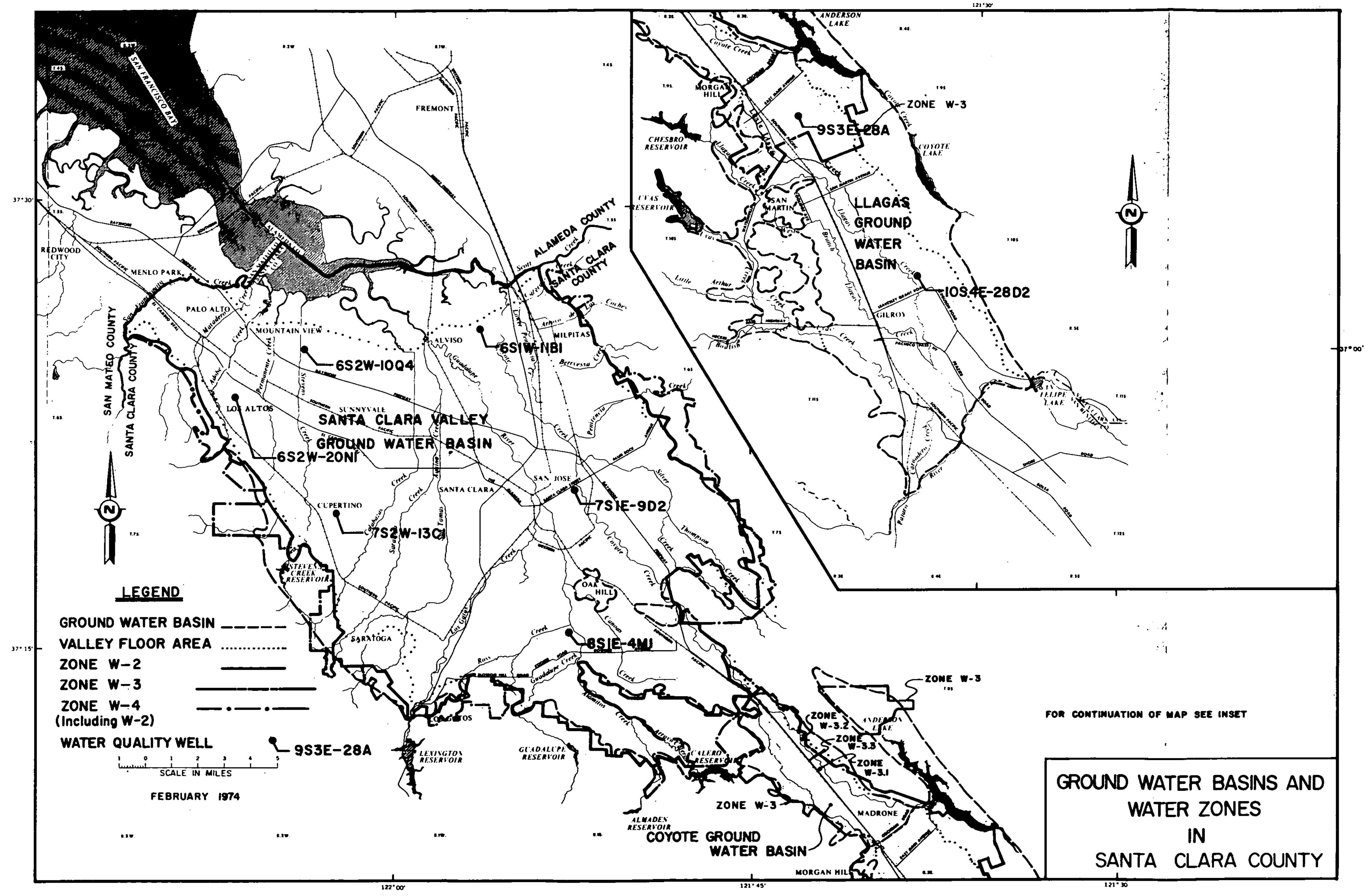
The region affected by sea water contamination is circumscribed by a line delineating the approximate limits of well water containing chloride concentrations greater than 100 mg/l (milligrams per liter) for the years 1949 through 1972 and is shown on Plate 5.

This region does not necessarily represent the area of sea water intrusion, in the strictest sense, as other sea water contamination mechanisms may now be operating or may have been operating in the past. Contamination is greatest near the Bay and decreases with increasing distance away from the Bay. Comparison of recent and historic groundwater chloride-concentration data indicates that although individual wells such as Well 6S/2W-10Q4, Figure 5, may show large variations in chloride concentrations, the limits of this region have not changed significantly with time.

Generally, contaminated water is restricted to the shallow aquifers, less than 150 feet deep. In some cases, water may be gaining access to lower aquifers through gravel packed wells, through wells perforated in both shallow and deep aquifers or through defective wells.

In addition to contamination from the Bay itself, sea water contamination may result from the migration of saline water up tidal channels where it may enter the adjacent groundwater body by percolation and diffusion into shallow groundwater aquifers adjacent to the stream. The potential for this type of contamination is highest in areas where shallow permeable materials are found such as along Guadalupe Creek. This mechanism is thought to be, in part at least, responsible for the basinward deflection of the 100 mg/l chloride line in the Guadalupe River region. Analysis of surface water samples collected by the District in 1964 along Guadalupe River 0.8 and 0.2 miles downstream from Montague Road at high tide showed chloride concentrations of 6,300 mg/l and 570 mg/l, respectively. Pumping from groundwater bodies adjacent to and inland from the regions where saline surface waters occur could lower the groundwater table and cause migration of this water toward these areas. This mechanism may be operating in other tidal channels peripheral to the Bay. Evidence of this is the high chloride concentrations observed in water extracted from wells and piezometers adjacent to bayland tributaries and tidal channels. For example, two wells within two miles of the Bay have yielded high chloride water. The first well, located adjacent to Stevens Creek and perforated from 32 to 35 feet and from 108 to 202 feet contained water with a chloride concentration of 1040 mg/l in May of 1965; the other well, adjacent to Permanente Creek, sampling the depth interval of 50 to 70 feet, in October of 1973 contained water with a chloride concentration of 1060 mg/l.

Refinement or adjustment of the area of sea water contamination may become necessary in the future as new data become available. Future plans for the sea water contamination study include electrical resistivity surveying in areas not yet investigated; expanding well sampling into the Mountain View and Palo Alto areas based on subsurface geology and well depth; and installation of piezometers to obtain new information where none exists.



GROUND WATER BASINS AND WATER ZONES IN SANTA CLARA COUNTY

PLATE I

LINES OF EQUAL GROUND WATER ELEVATION AS MEASURED IN WELLS SEPTEMBER 1, 1973

Santa Clara Valley Water District

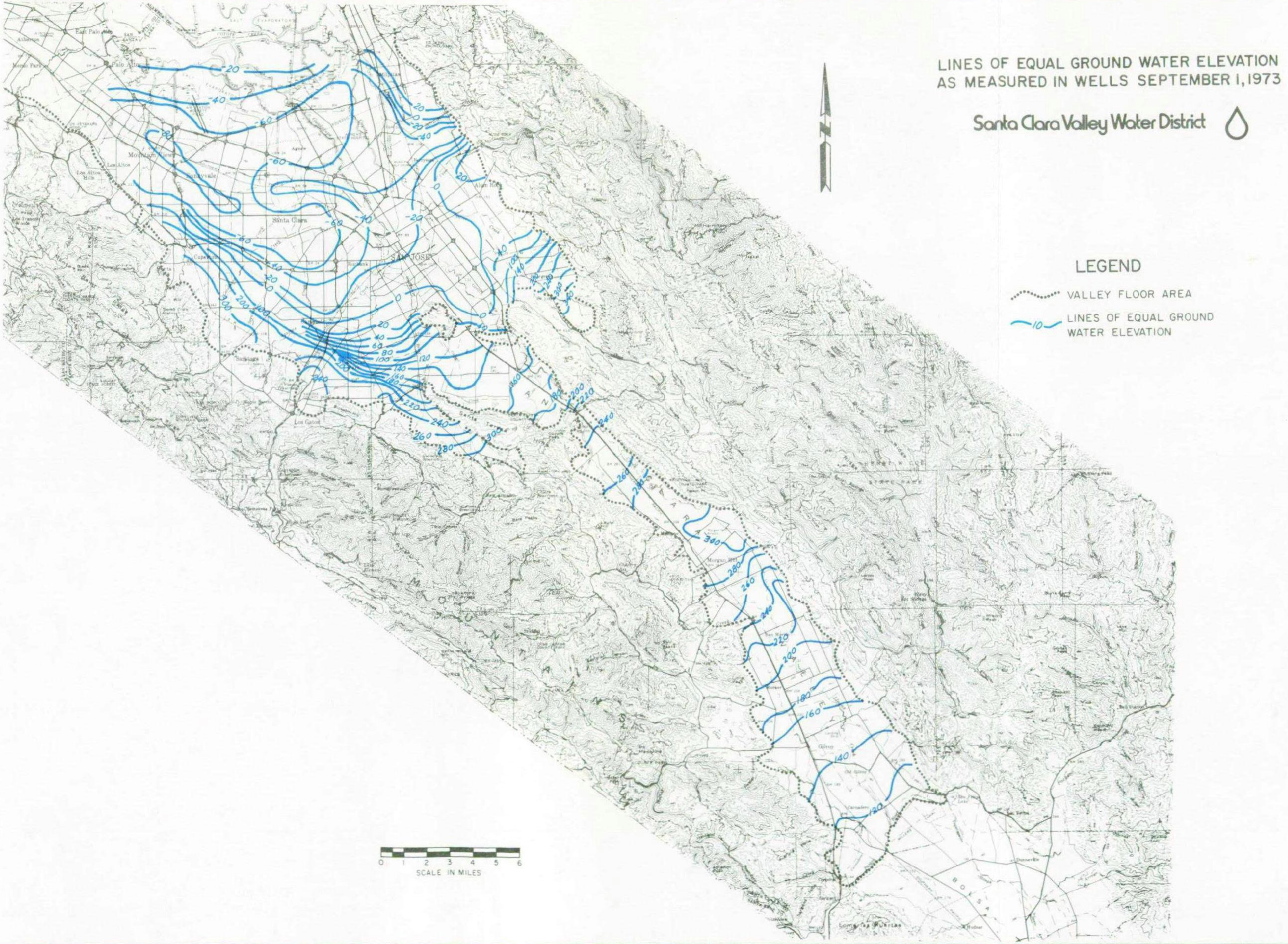


PLATE 2

LINES OF EQUAL CHANGE IN WATER ELEVATION IN WELLS FROM JUNE 1, 1972 TO JUNE 1, 1973

Santa Clara Valley Water District

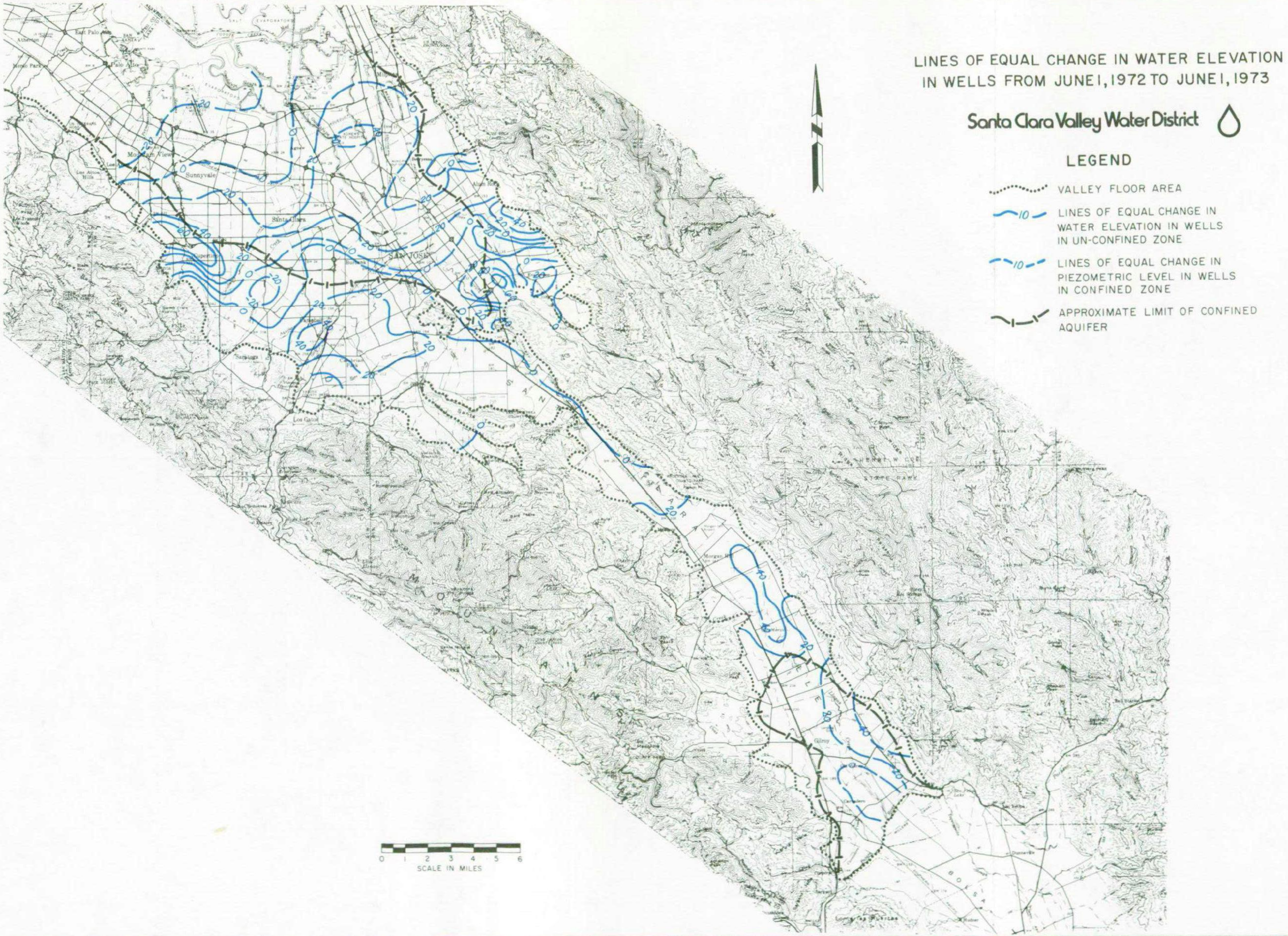


PLATE 3

LINES OF EQUAL DEPTHS TO WATER AS MEASURED IN WELLS SEPTEMBER 1, 1973

Santa Clara Valley Water District

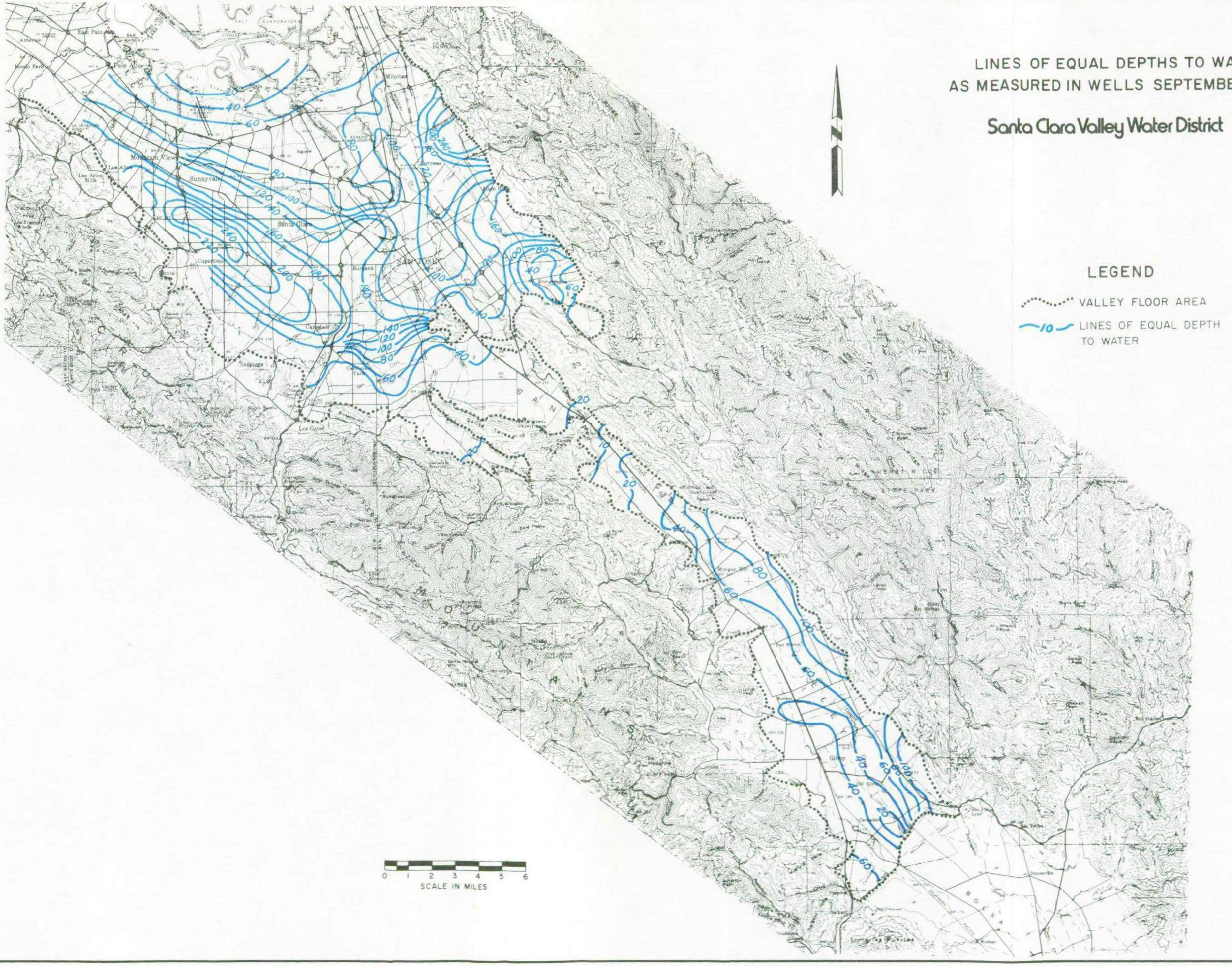
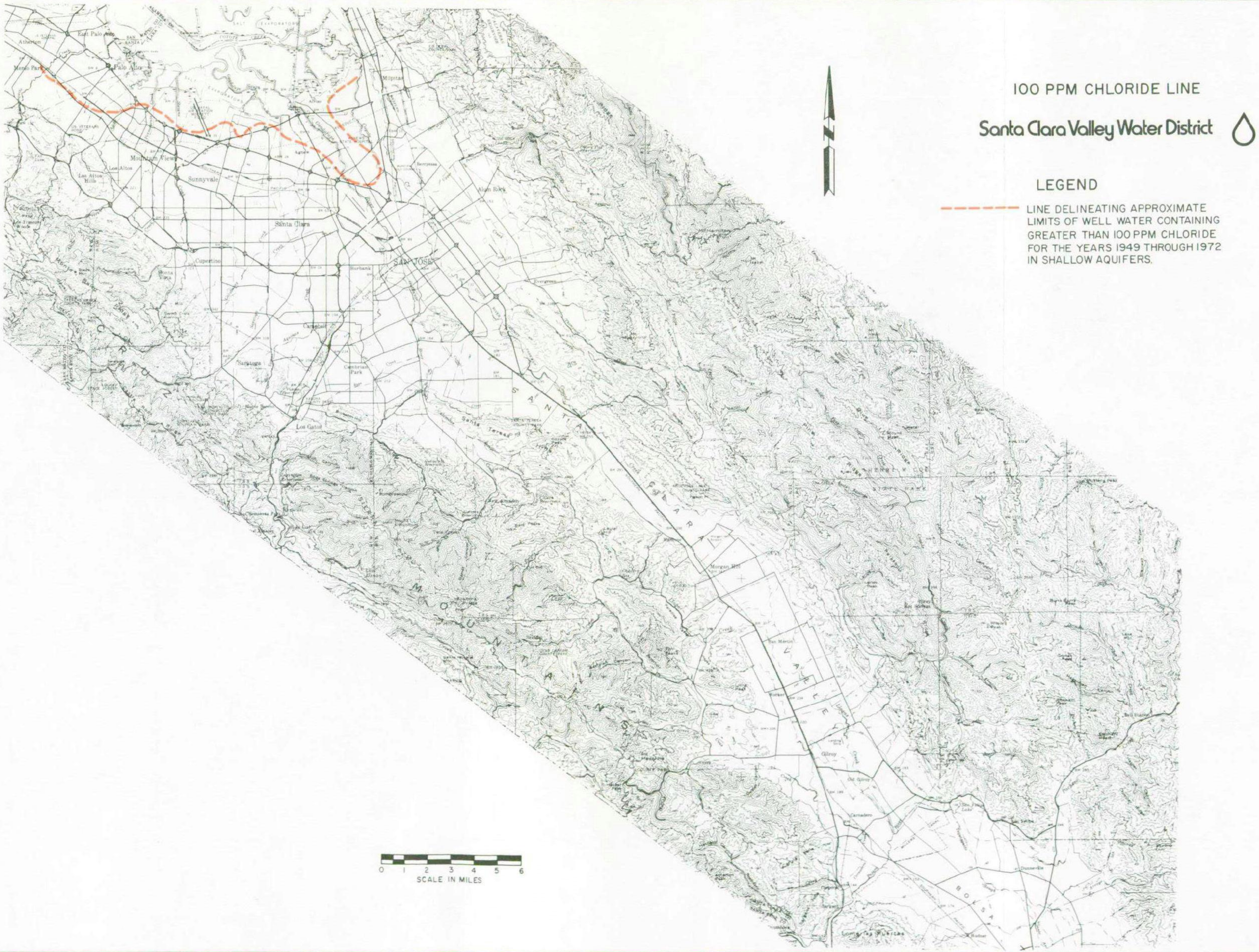


PLATE 4

100 PPM CHLORIDE LINE

Santa Clara Valley Water District



LEGEND

LINE DELINEATING APPROXIMATE LIMITS OF WELL WATER CONTAINING GREATER THAN 100 PPM CHLORIDE FOR THE YEARS 1949 THROUGH 1972 IN SHALLOW AQUIFERS.

PLATE 5